

## Claims

- [c1] 1. A chemical stripping method for selectively removing a diffusion aluminide coating from a substrate, comprising the step of contacting the coating with an aqueous composition comprising at least one acid having the formula  $H_xZrF_6$ , or precursors to said acid, wherein x is 1-6.
- [c2] 2. The method as recited in claim 1, wherein x is 1-3.
- [c3] 3. The method as recited in claim 1, wherein the acid is present at a concentration in the range of about 0.05 M to about 5 M.
- [c4] 4. The method as recited in claim 3, wherein the acid is present at a concentration in the range of about 0.5 M to about 3.5 M.
- [c5] 5. The method as recited in claim 1, wherein the precursor is a salt of the acid.
- [c6] 6. The method as recited in claim 1, wherein the aqueous composition comprises the compound  $H_2ZrF_6$ .
- [c7] 7. The method as recited in claim 6, wherein the  $H_2ZrF_6$  compound is formed in situ within the aqueous composition, by the dissociation of a corresponding salt of the compound; or by the reaction of a zirconium-containing compound with a fluorine-containing compound.
- [c8] 8. The method as recited in claim 7, wherein the zirconium-containing compound is  $ZrO_2$ , and the fluorine-containing compound is HF.
- [c9] 9. The method of claim 1, wherein the substrate is immersed in a bath of the aqueous composition.
- [c10] 10. The method of claim 9, wherein the aqueous composition is maintained at a temperature in the range of room temperature to about 100 °C.
- [c11] 11. The method of claim 10, wherein the aqueous composition is maintained at a temperature in the range of about 30C to about 85C.
- [c12] 12. The method of claim 10, wherein the substrate is immersed in the aqueous composition for a time period in the range of about 1 minute to about 10 hours.

- [c13] 13. The method as recited in claim 1, wherein the aqueous composition further comprises at least one additive selected from the group consisting of inhibitors, dispersants, surfactants, chelating agents, wetting agents, deflocculants, stabilizers, anti-settling agents, and anti-foam agents.
- [c14] 14. The method as recited in claim 1, wherein the diffusion aluminide coating comprises a diffusion sublayer over the substrate, and an additive sublayer over the diffusion sublayer.
- [c15] 15. The method as recited in claim 14, wherein the coating being removed is the additive sublayer, while the diffusion sublayer is substantially unaffected.
- [c16] 16. The method as recited in claim 1, wherein the diffusion aluminide material is a noble metal-aluminide, and the noble metal is selected from the group consisting of platinum, palladium, and mixtures thereof.
- [c17] 17. The method as recited in claim 1, wherein the substrate comprises at least one element selected from the group consisting of iron, cobalt, nickel, aluminum, chromium, titanium, and mixtures that include any of the foregoing metallics.
- [c18] 18. The method as recited in claim 17, wherein the substrate comprises a superalloy.
- [c19] 19. The method as recited in claim 18, wherein the superalloy is nickel-based or cobalt-based.
- [c20] 20. The method as recited in claim 19, wherein the superalloy is a component of a turbine engine.
- [c21] 21. The method as recited in claim 20, wherein the component comprises an airfoil.
- [c22] 22. The method as recited in claim 1, further comprising the step of removing coating residue after treatment in the aqueous composition.
- [c23] 23. The method as recited in claim 22, wherein the coating residue is removed by a technique selected from the group consisting of abrasion, tumbling, laser ablation, and ultrasonic agitation.

- [c24] 24. The method as recited in claim 23, wherein the abrasion is carried out by a grit-blasting technique.
- [c25] 25. A chemical stripping method for selectively removing a diffusion platinum-aluminide coating from a superalloy substrate, comprising the step of treating the substrate with an aqueous composition comprising at least one acid having the formula  $H_xZrF_6$ ; wherein x is 1-6.
- [c26] 26. The method of claim 25, wherein the substrate is treated with the aqueous composition in a bath, for a period of time sufficient to remove an overlying additive sublayer of the coating, while not substantially removing an underlying diffusion sublayer of the coating.
- [c27] 27. The method of claim 26, wherein the substrate is a turbine component or combustor component of a gas turbine engine.
- [c28] 28. A method for replacing a worn or damaged diffusion aluminide coating applied over a substrate, comprising the following steps:  
(i) chemically removing the worn or damaged coating by contacting the substrate with an aqueous composition, wherein the aqueous composition comprises an acid having the formula  $H_xZrF_6$ , where x is 1-6, or precursors to said acid; and then  
(ii) applying a new coating over the substrate.
- [c29] 29. The method of claim 28, wherein the diffusion aluminide coating comprises a diffusion sublayer which lies over the substrate, and an additive sublayer which lies over the diffusion sublayer.
- [c30] 30. The method of claim 29, wherein the additive sublayer is removed, while the diffusion sublayer is substantially unaffected.
- [c31] 31. The method of claim 28, wherein the new coating is a diffusion-aluminide coating or an overlay coating.
- [c32] 32. The method of claim 31, wherein the overlay coating comprises a composition of the formula  $MCrAl(X)$ , where M is an element selected from the group consisting of Ni, Co, Fe, and combinations thereof; and X is an element selected from the group consisting of Y, Ta, Si, Hf, Ti, Zr, B, C, and combinations thereof.

- [c33] 33. An aqueous stripping composition for selectively removing a diffusion aluminide coating from a substrate, comprising an acid having the formula  $H_xZrF_6$ , where x is 1-6, or precursors to said acid, wherein the acid is present in the composition at a concentration in the range of about 0.5 M to about 3.5 M.
- [c34] 34. The stripping composition of claim 33, further comprising at least one additive selected from the group consisting of inhibitors, dispersants, surfactants, chelating agents, wetting agents, deflocculants, stabilizers, anti-settling agents, and anti-foam agents.
- [c35] 35. The stripping composition of claim 33, in which a gas turbine engine component is immersed.

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